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where $\lambda' \equiv 1/\alpha + 1/\beta$. From λ and λ' , we can obtain α and β .

If now α_1, β_1 are a harmonic pair obtained from (3) and (4), then the bilinear transformation

$$x = \frac{\beta_1 x' + \alpha_1}{x' + 1}$$

will reduce the general quartic (1) to the required form.

In case two of the roots of (1) are equal, say $x_1 = x_2$, then equation (3) will have a repeated root which will equal twice the reciprocal of x_1 , the repeated root of (1); and if three roots of (1) are equal, then all harmonic pairs coincide at the repeated root and (3) will be a perfect cube. Thus we see that the general quartic with real or complex coefficients can be reduced to the form (2) in this way.

REMARKS ON THE REPORT ON GEOMETRY OF THE COMMITTEE* OF THE CENTRAL ASSOCIATION.

By PROFESSOR GEORGE BRUCE HALSTED, Greeley, Colorado.

This report is epoch-making,—at the very least epoch-marking.

There simply *must* be things not *explicitly* defined, and point, straight, plane, between, should be among them. The Report says: “It is recommended that the term *sect* be used for segment of a straight line lying between two of its points.” In fact the term “sect” has ‘arrived.’ The Encyclopaedia Americana uses it. This Report uses it more than twenty-two times. It is used not less than twenty-four times in the remarkable Presidential Address by Professor Alfred Baker of the University of Toronto to the Royal Society of Canada.

Think of the neatness with which the bunglesome phrase “transferrer of straight-line segments” becomes *sect-carrier*. Realize how elegantly “the algebra or algorithm of straight-line segments” becomes *sect-calculus*.

“Instead of *axioms*,” says the Report, “use geometrical *assumptions*.” It gives for example Pasch’s assumption, now so renowned. From the list of assumptions we mention: “3. A point on a straight line divides it into two parts, called *rays*.” “6. A sect has one and only one mid point.” “11. A straight line divides the points not on it into two classes such that sects determined by two points of the same class are not intersected by the line, and sects determined by two points not of the same class are intersected by the line.”

*The Committee consist of G. W. Greenwood, Chairman, Salem, Va.; C. A. Pettersen, Chicago, Ill.; C. E. Comstock, Peoria, Ill., and C. W. Newhall, Faribault, Minn. Copies of the report may be had by sending a stamp to Miss Mabel Syker, 438 East 57th Street, Chicago, Ill. Ed. S.

"Definitions," says the Report, "should not be based upon crude images, affording little upon which reasoning may lay hold. For example, 'An angle is the opening between two lines which meet.' Instead, define an angle as the figure formed by two rays having a common origin." A demonstration in which we use information obtained by looking at a figure is not of the highest order.

The one serious slip in the Report is the sentence: "Also, in 'A line perpendicular to each of two intersecting lines (at their intersection) is perpendicular to their plane,' we assume that two intersecting lines have a common perpendicular though we cannot justify the assumption by any previous proposition." Halsted's Rational Geometry here makes no assumption whatever. Its figure for this proposition is already covered by the preceding proposition: On any straight to put two planes; and the problem: To erect a perpendicular to a straight from any point on it.

We must agree with the Report, that the treatment of mensuration in most texts is extremely unfortunate. In fact measurement in terms of a common unit at once introduces incommensurability and irrational numbers. No geometry exists in which irrational numbers are adequately treated. Halsted's Rational Geometry outwits the difficulty.

The committee recommends that a critical course in elementary geometry be offered in courses of study in colleges.

DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

Remarks on Two Solutions of Problem 89. By G. A. MILLER.

The following solutions present very instructive examples of fallacious reasoning and arriving at the answer by a remarkable coincidence. As the problem is so well known, and these solutions are said to have appeared in other scientific journals it seems desirable to enter into some details. The problem is as follows:

Solve by quadratics, $x^2 + y = 7 \dots (1)$, $x + y^2 = 11 \dots (2)$.

We shall first speak of the solution given on page 37, Volume VI, of this journal. To make the matter as clear as possible we shall employ the language of analytic geometry. The problem is to find the common points (or at least one of them) of two intersecting parabolas. The author of the solution in question subtracts (2) from (1), and thus obtains the equation of an equilateral hyperbola containing the four common points of the given parabolas. The equation of this hyperbola is